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NASA TECH BRIEF

Lewis Research Center

Design Criteria Monograph for Liquid Propellant Gas Generators

A design criteria monograph has been published which is a summary and a systematic ordering of the large and loosely organized body of existing successful design techniques and practices for liquid propellant gas generators.

This monograph was written to organize and present, for effective use in design, the significant experience and knowledge accumulated by NASA in development and operational programs. It reviews and assesses current design practices, and from them establishes firm guidance for achieving greater consistency in design, increased reliability in the end product, and greater efficiency in the design effort.

Gas generators commonly are subdivided into bipropellant and monopropellant, the distinction depending upon the propellant type used. The main emphasis of this monograph is on bipropellant gas generators because they are much more widely used than monopropellant gas generators.

The successful development of liquid propellant gas generators presented many problems. The major problem in all bipropellant gas generators is that of hot streaking. Since turbines have definite temperature limitations, the stratification of gases even at reasonable overall mixture ratios can cause severe damage to the blades and also to the ducts, turbine manifold, and even the gas generator itself. Most propellant combinations are capable of producing temperatures well above the melting point of common metals, and combustion can take place at local temperatures well above that of the mixed gas. Cooler propellant must be mixed with the combustion products to produce a gas of proper temperature. Thus any design that allows combustion to occur too near a wall or one that does not mix the hot and cold streams quickly will produce a catastrophic failure. The primary concern of the designer must be to control the location of the combustion zone and the process of mixing hot and cool streams.

Monopropellant gas generators have had limited application. Only two monopropellants have had any significant usage: hydrogen peroxide and hydrazine. The monograph covers thoroughly the design problems and solutions associated with gas generators using these monopropellants.

The monograph comprises two major sections: State of the Art, and Design Criteria and Recommended Practices. References complement the text.

The State of the Art section reviews and discusses the total design problem, and identifies the design elements that are involved in successful design. The Design Criteria state clearly and briefly each rule, guide, limitation, or standard that must be imposed on each essential design element to ensure successful design; the Recommended Practices set forth the best available procedures for satisfying the Design Criteria.

Both major sections are divided into four subject categories: Bipropellant Gas Generators (chamber, injector, accessories), Monopropellant Gas Generators (chamber, catalyst, injector, accessories), Common Problems (pressure measurement, temperature measurement), and Testing (bipropellant gas generator, monopropellant gas generator).

This thorough review of design criteria relating to liquid propellant gas generators should be of interest to manufacturers or users of gas generators for applications such as auxiliary power drives, pressurization sources, preburners for thrust chambers, and turbine drives.

Notes:

1. This monograph has been published as:
   NASA SP-8081 (N73-27705), Liquid Propellant Gas Generators
   Copies may be obtained at cost from:
   Aerospace Research Applications Center
   Indiana University
   400 East Seventh Street
   Bloomington, Indiana 47401
   Telephone: 812-337-7833
   Reference: B74-10008
2. Specific technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B74-10008

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